

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : WO 94/14114
G06F 9/00, 13/14 A1 (11) International Publication Number:
(43) International Publication Date: 23 June 1994 (23.06.94)

(21) International Application Number: PCT/US93/11506

(22) International Filing Date: 29 November 1993 (29.11.93)

(30) Priority Data: 987,365 7 December 1992 (07.12.92) US

(71) **Applicant:** OVERLORD, INC. [US/US]; 90 South LaSalle Street, Suite 2760, Chicago, IL 60603 (US).

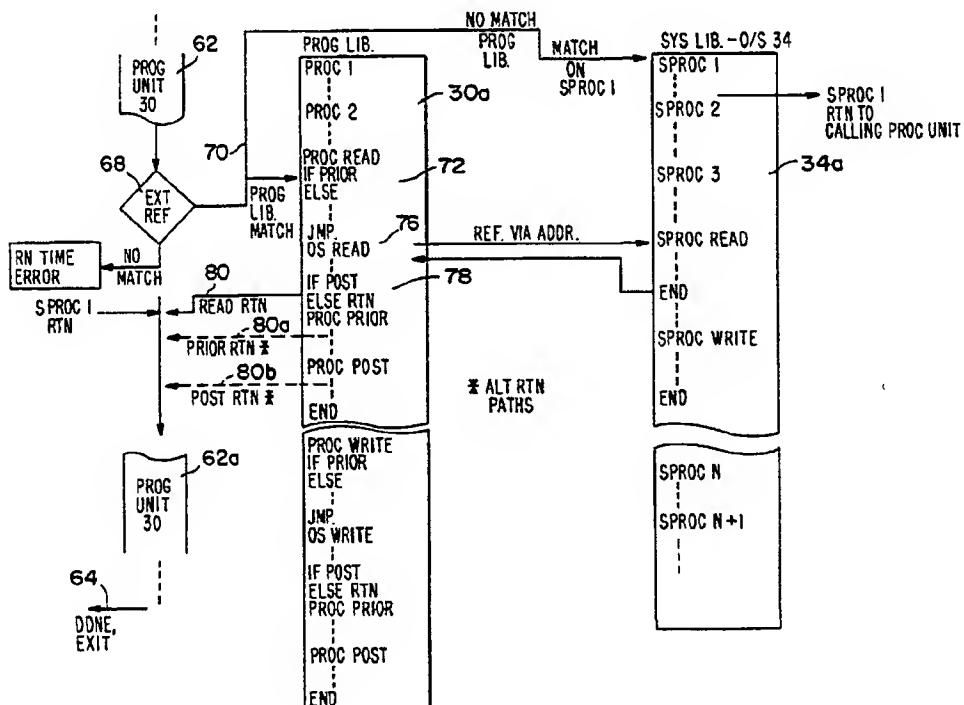
(72) Inventor: KENNEDY, Donald, J.; 1725 Westbridge Court, Southbridge Commons, Schamburg, IL 60194 (US).

(74) Agents: VARGO, Paul, M. et al.; Dressler, Goldsmith, Shore & Milnamow, Two Prudential Plaza, Suite 4700, Chicago, IL 60601 (US).

(81) Designated States: AU, FI, HU, JP, KR, NO, NZ, PL, RU, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With *international search report*.

(54) Title: INTERCEPTION SYSTEM AND METHOD INCLUDING USER INTERFACE



(57) Abstract

A method of intercepting pre-existing computer instructions in order to modify and/or enhance pre-existing program units (30) and supply user entry points determines, in one or more embodiments, if a reference can be found in a program unit (30). If so located, the corresponding method provides user code entry points (steps 72, 78) before and after the intercepted instruction, perhaps in modified and/or enhanced form, is executed (step 76). Blocks of user supplied code can be provided at the entry points to enhance, upgrade, and/or expand upon the intercepted instruction, thereby enhancing the pre-existing program unit (30).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

- 1 -

INTERCEPTION SYSTEM AND METHOD
INCLUDING USER INTERFACE

Field of the Invention

5 The invention relates to single and multiprocessor computer systems that supply system services to requesting program units running on or in such systems. More particularly, the invention relates to methods of enhancing or modifying the run-time operation of selected, pre-existing program units.

10 Background of the Invention

15 Computer systems have, over a period of years, evolved from stand-alone individual processors to various forms of multi-processor systems. Many computer systems use program units, sometimes referred to simply as "programs".

20 The program units contain computer instructions which the computer system can execute in order to perform specific functions. These program units may have been created from other program units. However, in most cases, a human being was involved at some point in the creation of the set of computer instructions being executed.

25 Program units are intended to meet certain known or projected needs when implemented. However, most program units designed in the past or being designed in the present will not conform to all future needs.

30 Prior art systems have approached the need to be flexible to deal with future needs in many ways. In many cases, prior approaches have not been cost effective and/or do not allow the user many options on their implementation.

- 2 -

5 The evolution and combination of new hardware systems, new operating systems, new program units, new system procedures, new data structures, or new user interfaces may require that the original program units
10 be modified, recompiled, or worse, abandoned due to compatibility and/or cost related problems. Some of the prior art approaches require extensive training on both the use and implementation of these methods. Some users may not be able to afford the time, money, and human resources to implement the prior art approaches.

15 This need for flexibility in updating or modifying existing programs is especially apparent in multi-processor distributed systems. Several different types of problems have provided the impetus to the drive toward multi-processor systems.

20 One impetus has been a desire to share information more effectively among diverse users. An approach to this problem has been to couple a variety of processors, which may or may not be the same, together via a local area network. Such networks enable many different individuals and their associated processors to have access to common information and to have access to one another.

25 Yet another impetus toward multi-processor environments has been a desire to create highly reliable computer systems out of less reliable components. Such systems are typically used in environments such as banking, transaction processing, or inventory control, wherein reliability is of paramount importance.

30 One such family of computer systems is marketed by Tandem of Cupertino, California. Tandem systems can be implemented in stand-alone, multiple processor configurations, or as multiple interconnected nodes. Each node corresponds to one or more multiple processor systems.

35

- 3 -

5 Where major program systems, which might include dozens of program units, to support multiple remote transaction terminals or inventory control functions are installed and running on a production basis in a multiple processor environment, the above-noted problem of updating and maintaining program units becomes very difficult and expensive to solve. For example, a new operating system might be adopted by the hardware vendor. In such an instance, the system 10 operator might have to install the new operating system to receive continuing support and operating system maintenance.

15 If the change in operating systems is not transparent to the existing program systems, they may need to be modified or recompiled. This process is not only expensive and time consuming, but in a multi-program, multi-processor environment can result in errors which could cause catastrophic results.

20 In addition, where the software had been obtained from a third party vendor, the user might not have the source code or documentation necessary to make modifications, expansions, or recompilations. Worse yet, the third party vendor will, in all likelihood, not continue to support or provide new releases to the user.

25 Thus, there continues to be a need to be able to safely upgrade or modify existing programs in a cost effective fashion as the requirements or the environment change. Preferably, this need could be met by system operating personnel without a need to return to the 30 original software vendor or to modify the original provided program units.

35 In addition, in a multiple processor system, the operating environment is continuously changing. As a result, the mix of resources, available processors, and the like, available each time a program unit or a

- 4 -

process is initiated, will be different, depending on what other program units or processes are active at any given time.

5 Thus, there is continuous problem of resource allocation and management which must be addressed in such systems. One known approach, marketed by the assignee of the present application under the name of "Automatic Network Balancing System" for Tandem computers, provides resource allocation services and 10 resource management in such environments based on predetermined and fixed allocation methods.

15 In the known automatic network balancing system, the performance factors which are taken into account to select the best or most appropriate processor to which a process is to be allocated, include availability or busy state of a given processor, available memory, swap rate, dispatch rate, memory queue length, jobs that are available on the ready list, as well a number of others. The various performance 20 factors are evaluated using a weighing system. The processor which appears to be most appropriate is then selected to run the process.

25 The known load balancing system has been very successful and can be used to substantially increase performance of Tandem-like systems. Nevertheless, the method of selecting the most appropriate processor to be allocated to carry out a given task does not take into account site or user needs for diversity or customization between one installation and another.

30 Thus, there continues to be a need for a more flexible approach which can take into account variations from site to site. Preferably, such an approach could be implemented to allow site specific input to the processor selection process or to expand upon the 35 services provided to a given process which is being

- 5 -

executed. Preferably, the implementation will be transparent to the respective process.

Summary of the Invention

5 This invention is directed to an apparatus and a method of run-time interception of pre-existing computer instructions in program units in order to support user hooks or entry points which can be used to modify and/or enhance the originating and/or receiving 10 program units, at the user's discretion. As a result, the program units can meet the user's present needs and allow modification by the users, on an as needed basis, to support the future needs. Using the present 15 invention, this can be accomplished without requiring the support and/or guidance and/or expertise of the original authors and/or inventors of the program units being intercepted or any additional physical, electronics, or mechanical device.

20 The above result is achieved by intercepting system service calls which are made by executing program units at run time when the program units request that the operating system of the computer system provide a service on their behalf. The interception can take 25 place in the main program units, user library program units, system library program units, or a combination of the program units listed above.

30 The method also contemplates that the interception of the system service calls and user hooks or entry points would be placed in several types of program units. This gives the users many options as to where the interceptions of the system service calls will take place. Further, it allows the user to implement the invention on a program unit by program unit basis, if desired, or to implement the invention on a system by 35 system basis.

- 6 -

5 In accordance with one aspect of the invention, an apparatus and a method are provided for altering or translating one or more steps of a pre-existing method for carrying out a predetermined function. Site or user defined steps or functions can be incorporated into the process for customization or specialization.

10 The method can be used, for example, for allocating resources within a multiple processor computer system. In other aspects of the invention, different types of functions can be implemented beyond those specified in the pre-existing method.

15 The method includes detecting a step which is a candidate for alteration. The alteration process could include carrying out a different function from that which the step initially requested, or for translating or expanding upon the step.

20 A determination is made if a previously defined, user supplied, pre-alteration set of steps is to be executed before carrying out one or more predetermined altering or translating steps. In response to this determining step, the group of site or user supplied pre-alteration or pre-translation steps is executed as indicated.

25 The method then includes executing the one or more predefined altering or translating steps. Such steps could include, in accordance with one aspect of the invention, determining which of a plurality of available resources is to be used to carry out the requested step which is the candidate for alteration.

30 Alternately, the predefined altering steps could provide enhanced functions not called for in the original candidate steps. Such enhanced functions may have become desirable, so long as they can be provided

- 7 -

so as to be transparent to the original candidate step or steps.

5 The method then makes a determination as to whether or not there are one or more post-alteration, site or user supplied steps. These steps can then be executed as indicated after executing the set of altering steps.

10 In accordance with yet another aspect of the invention, the method can be used for the purpose of allocating resources within a multiple node, multiple processor system. Each of the nodes can include one or more computer processors. The nodes can be physically displaced from one another, and can be coupled together via communication lines.

15 This aspect includes the steps of:
 carrying out a sequence of steps in a predetermined process;

20 detecting a step in the sequence which is to be carried out and which is a candidate for translation;
 intercepting the detected step and determining if a previously defined, user supplied, pre-translation set of steps exists;

25 interrupting the sequence and executing the user supplied pre-translation set of steps as indicated;

 translating the candidate step into a predetermined sequence of one or more predetermined translated steps;

30 subsequent to the translation step, determining if a previously defined, user supplied, post-translation set of steps exists;

 executing the user supplied, post-translation set of steps as indicated; and

 returning to the sequence of steps immediately after the detected step, thereby continuing the process.

- 8 -

5 In yet another aspect of the invention, the method can be used for the purpose of resource allocation for the purpose of not only optimizing processing throughput, but also for the purpose of creating redundant databases automatically in spaced apart locations for purposes of other functions, such as disaster recovery, for instance.

10 These and other aspects and attributes of the present invention will be discussed subsequently with reference to the following drawings and accompanying specification.

Brief Description Of The Drawing

15 Figure 1 is a schematic diagram of a multiple node, multiple processor network;

Figure 2 is a schematic diagram of an environment in which a program unit might be executed;

Figure 3 is a flow diagram of a method in accordance with the present invention; and

20 Figure 4 is a flow diagram of an alternate method in accordance with the present invention.

Detailed Description of the Preferred Embodiment

25 While this invention is susceptible of embodiment in many different forms, there is shown in the drawing, and will be described herein in detail, specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

30 The present method makes it possible for a program user or a system operator to update and modify pre-existing programs without requiring the recompiling of the source codes of the respective program unit(s).

- 9 -

5 This is accomplished by intercepting selected calls or references to procedures, program units, or variables that can be external or internal to a pre-existing executing program unit. One type of interceptable instruction is an operating system service call.

10 On interception, the operating system will look for the called procedure in a library linked to the executing program unit, if such exists. In the absence of a program related library, or in the absence of a match with the called procedure in the executing program unit, the operating system will then attempt to find the called procedure or program unit in its system library.

15 Where a match is found in either the program library or the system library, that procedure or program unit is then executed. If there is no match, an indication of a run-time error should be returned to the calling program unit.

20 The present method makes available "user hooks" in the respective library procedures or program units. The phrase "user hooks" as used herein refers to intentionally created entry points or steps wherein a user or system operator can insert one or more computer instructions (blocks of code) for the purpose of transparently updating or modifying the executing program unit. Hence, the user has greater control over its computer system(s) and is able to make modifications or enhancements outside of the executing program unit. This avoids any need to modify or recompile that program unit.

25 30 Another advantage of the present method is that it can be used where the program library is incorporated into the program unit itself. The user hooks provide a way for a user or operator to create a bridge between various versions or releases of software packages, as well as program units.

- 10 -

Figure 1 illustrates schematically a multiple processor computer network 10. The network 10 includes a plurality of nodes 12 through 18.

5 Each of the nodes 12 through 18 can include one or more computer systems. Representative examples include Tandem-type multiple processor computer systems which might include up to 16 processor modules.

10 It will be understood that a node, such as node 12, could be implemented as a stand-alone, single processor computer system. Neither the number of processors, nor the architecture thereof, nor the presence or absence of communication links are a limitation of the present invention. The present invention can be advantageously practiced in conjunction 15 with a single, stand-alone system.

Each of the nodes 12 through 18 can communicate with at least one other node via communication channels, such as the channels 20a through 20e. The network 10 can be geographically disbursed with the nodes 12 through 18 coupled, at least in part, via long distance communication links or other communications methods.

25 Figure 2 illustrates schematically a program unit 30 which is to be executed on a processor 32. As is conventional, the program unit 30 communicates with the processor 32 via an operating system 34. The operating system 34 provides a variety of services to the executing program unit.

30 The program unit 30 and operating system 34 would normally be stored in one or more storage devices or units of the processor 32. The details of such storage and the process wherein the operating system 34 initiates executing of the program unit 30 on the processor 32 are known and are not a limitation of the 35 present invention.

- 11 -

As has long been recognized, one aspect of an operating system is to enhance the efficiency of utilization of the processor 32 as well as to improve the speed and ease of creation of programs such as the program unit 30. In this regard, the operating system 34 provides a variety of predefined commands, so-called "System Service Calls" (SSC), which carry out certain predefined functions when requested by a calling program unit.

Representative system service calls include a command to carry out a "read" function. A "read" request, based on supplied parameters, could request a read from a disk drive or other types of magnetic storage, or could request a read from a terminal or other devices.

Alternately, the operating system might support a system service call, such as a "write" to a storage unit or a device. A "write" request could send data or programs to communication lines, printers, or the like. A more extensive list of system service calls of a type supported by Tandem's GUARDIAN Operating System is attached hereto as Exhibit A.

In accordance with the present invention, there is interposed between the program unit 30 and the operating system 34 a functional layer 36 which includes the "user hooks" or entry points. At these points, an operator, a user, or a site can expand upon or modify external references or calls intercepted by the operating system.

Once an instruction has been intercepted, a first user hook is then checked or executed. This entry point can include an initial block of user or operator supplied code. This initial or "prior" block is to be executed before any modification and/or enhancement of

- 12 -

the function which is the subject of the intercepted instruction is carried out.

5 The intercepted call or service request may then be executed as required. This execution, as described below, can be modified and/or enhanced, or expanded upon in a predetermined fashion.

10 Then, a second user hook or entry point may be checked or executed to determine whether or not there is any post-translation, user, or site specific code which is to be executed. If so, that code is executed. Finally, appropriate parameters and/or data may be returned to the program unit 30 which had previously made the service request or call.

15 In accordance with the present invention, the interception process is carried out in one embodiment using a hierarchy that is very often imposed by the operating system between program library calls and system library calls. As a first step in carrying out the call or the functional request, if a program library 30a is associated with the program unit 30, the operating system 34 checks the program library 30a first to determine if the intercepted external reference or call is present in the program library.

20 By providing counterparts in the library 30a to some or all of the system service calls or functions of the operating system 34 before the operating system intercepts requests for such services from the program unit, the corresponding procedure in the program (not the system) library will be executed. This provides a vehicle to modify or expand such requests in a pre-determined fashion.

25 Hence, by associating with the program library structure 30a, a plurality of modified operating system calls, when the program 30 executes a particular service call, service can be provided in accordance with that

- 13 -

request. In addition, on a substantially transparent basis to the executing program unit, the service can be enhanced and/or modified, or completely changed in a predetermined fashion. If and when the appropriate 5 parameters and/or data are then returned to the program unit 30, that program can then continue executing subsequent instructions.

It will be understood that the library 30a is not required to practice the present method. An 10 equivalent structure can be implemented in the operating system 34 as discussed subsequently or in the program unit 30 itself.

Example 1 illustrates the process. Subsequently referred to line numbers are listed along 15 the left-hand margin of Example 1.

In Example 1, a read operation present in the program unit 30 could be intercepted and/or modified or translated on a substantially transparent basis in the interface layer 36. Line 40 of Example 1, defines the 20 procedure to be executed as a "read" function with n parameters associated therewith.

The read process begins in a line 42. Line 44 represents a first user hook or entry point. A call is made to a procedure which includes one or more 25 previously specified site specific or operator specific instructions which are not normally part of the "read" procedure. Subsequent to the execution of the procedure of line 44, the actual "read" procedure can be carried out as indicated schematically in line 46.

It should be noted that the actual read 30 procedure which could be carried out could be a read procedure which is expanded and/or substantially different from the originally contemplated and specified read procedure in the calling program unit 30. Thus, a

- 14 -

bridging function can be provided, if necessary, between different program versions and/or releases.

- 15 -

```
40      PROC READ (1, 2 .... n)
42      BEGIN
44      CALL PRIOR (1, 2 .... n)
46      JUMP TO READ FUNCTION VIA O/S LOGICAL ADDRESS
5      48      CALL POST (1, 2 .... n)
50      END
          PROC PRIOR (1, 2 .... n)
          BEGIN          USER INSTRUCTIONS CAN BE
10          INSERTED AT THIS POINT IF
          DESIRED
          END
          PROC POST (1, 2 .... n)
          BEGIN          USER INSTRUCTIONS CAN BE
15          INSERTED AT THIS POINT IF
          DESIRED
          END
```

20

EXAMPLE 1

- 16 -

Line 48 is a second user hook or entry point. A procedure is called which includes one or more site specific or operator specific instructions which may be carried out after the read function is carried out. The 5 end of the procedure is indicated in line 50.

It will be understood that the location, number, or function of the user hooks are not a limitation of the present invention. In addition, the 10 present invention contemplates the use of multi-levels of entry points, such as in the program unit, the program library, or the system library.

Upon a return from the read procedure of Example 1 to the program unit 30, that program will 15 continue execution which can be based on returned parameters or data, if any, which resulted from the read procedure initiated therein. Hence, information actually supplied to the program unit 30 could come from a completely different location and/or source than that 20 originally contemplated by the program unit 30 and this change could be completely transparent thereto.

Figure 3 illustrates a flow diagram of an embodiment of the method of the present invention. The process of Figure 3 will be explained below in combination with the text of Example 1. In the 25 embodiment of Figure 3, the program library 30a has been previously linked to the program unit 30 and is available at run time. Using the above-noted hierachal approach, the operating system 34 checks the library 30a first when the program unit 30 calls an external 30 function or service, or tries to initiate execution of an external procedure.

The library 30a has been previously loaded with procedures corresponding to at least some of the external references for the program 30. The names of 35 some of the previously loaded library procedures must be

- 17 -

the same as the names of system service calls that are to be expanded upon and/or modified. (Usually, this is regarded as an error to be carefully avoided!)

5 In addition, it is necessary to be able to acquire, usually via the operating system, the logical address(es) of the respective system service call(s) in the operating system's library to be intercepted. The respective library procedure requires this information to be able to call that service function without using 10 the name thereof.

15 For instance, in Example 1, a "read" system service call is to be intercepted and/or modified. The program library, as a result, includes a PROC READ. In line 46, to call the actual read in the operating system library, a: JUMP TO LOGICAL ADDRESS OF SSC READ must be 20 executed to prevent PROC READ from calling itself.

25 Referring to Figure 3, the execution of the program unit 30 has been previously initiated. Step 62 represents execution of the program unit 30 until an 30 external request of some sort is made or until the program unit 30 is completed, at which point it terminates in a step 64.

35 In the event that the program unit 30 makes an external request, such as a request for a "read" or "write" for example, the operating system 34, in step 68, first checks the program library 30a, if any, to determine whether or not this function or procedure is found therein. If the called function, procedure, or external reference is located by the operating system 34 in the library 30a, for example, the "read" procedure of Example 1, that procedure is initiated.

40 In a step 72, the first user hook or entry point is encountered. This corresponds to the call at line 44 of Example 1. If there exists operator or site specific procedures and/or code, such steps should be 45

- 18 -

executed. This corresponds to carrying out the procedure of line 44 of Example 1.

5 In a step 76, the system service call or other function, called by program unit 30, is carried out, corresponding to carrying out the "read" function of line 46 of Example 1. The executed procedure from the operating system that is executed may be different from that contemplated by the creator of the program unit 30.

10 In a step 78, the second or "post" user hook or entry point is encountered. This corresponds to carrying out the procedure of line 48 of Example 1. Then, there is a return to execution of the program unit 30 in a step 80. While executing user hook instructions, alternate return paths, such as step 80a 15 or step 80b could be provided by the user.

20 In this example, if the called procedure or service request is not found in the library 30a, and if it is in the system library, then, in a step 70, the requested service or procedure is carried out, perhaps in combination with other services of the operating system 34. Any necessary parameters and/or data are returned to the program unit 30 which continues executing in step 62a.

25 As can be observed from the process of Figure 3, as a result of the site specific user supplied pre-translation and/or pre-modification steps, the first user hook, such as the process 44, along with the post-translation or post-modification steps, such as the process 48, it is relatively easy for an operator and/or a user to provide extensions, translations, and/or modifications to the original function being requested by the program unit 30. These are all outside of the program unit 30 and are substantially transparent to it.

30 35 Figure 4 illustrates an alternate embodiment of the present invention. In the embodiment of Figure

- 19 -

4, the program unit 30 need not have a library 30a associated therewith.

5 However, the names of the procedures or system service calls in the operating system library have been previously altered to distinguish them from the called procedure or "system service call" to be intercepted. With this change, the actual operating system call, under the new name, can subsequently be made. One of these procedures could correspond to the "open" 10 procedure. Renaming pertinent system service routines in the system library, such as "open to "sopen", as illustrated in Figure 4, step 34b, can be done when the operating system is compiled and linked together. In addition, corresponding procedures, as illustrated in 15 Figure 4, step 72a, must be loaded into the system library with the original names of the system service calls to be intercepted.

20 If the respective system library procedures of the operating system had been previously modified and expanded upon as described above, it would be possible to carry out a corresponding user specified "prior" procedure as identified on line 44 of Example 1 in step 72a, analogous to the step 72 previously discussed. After executing corresponding and/or similar system 25 service calls in step 76a, the user defined instructions represented by the "post" procedure of Example 1 can be executed in a plurality of steps 78a. Subsequently, the operating system 34 returns appropriate parameters and/or data, if any, to the program unit 30, which then 30 continues executing in a step 62a.

35 Using the previously described method, either the embodiment of Figure 3 or that of Figure 4, makes it possible for a user and/or operator to upgrade, maintain, and/or modify program units, such as the unit 30, to deal with both a changing environment and also

- 20 -

changing functional requirements, now and in the future. It is also possible to modify and/or upgrade system service calls so as to provide substantially different and/or enhanced functions not previously available to 5 the corresponding program units, such as the program unit 30, as well as operating system 34.

The above-described instruction interceptions are carried out at run-time, and are substantially transparent to the executing program unit. Source code 10 for the program unit is not required to practice the present method.

By making the "user hooks" or entry points available, as described above, both before and after executing the corresponding system service calls, for 15 example, users and/or operators will be able to more effectively manage, maintain, and upgrade their program units in a very cost effective fashion. Further, because the present method is substantially external to the respective program unit, there should be no impact 20 to third party vendor or maintenance relationships.

Additional representative examples of ways in which the methods of Figures 3 and/or 4 could be used include improved resource allocation in a multi-processor environment by including provision for user specific and/or operator specific modification to resource allocation 25 routines. Redundant write operations can be provided when carrying out the write function to provide multiple, substantially transparent, sets of data which can be used for verification, disaster recovery functions or the like.

30 Thus, in accordance with the present invention a user interface is provided to, on a substantially transparent basis, modify requests made by an executing program unit for a variety of purposes. This modification process takes place substantially outside of the program 35 unit. It can be substantially outside of the associated

operating system but can be readily modified by the operator and/or the user for purposes of customization.

The present invention has been discussed in terms of translating and/or modifying instructions at run time in 5 a program unit, such as the exemplary program unit 30. It will be understood that the present methods can be used with any type of program unit, such as an application, a utility, or the like. Hence, the present method could also be used to translate and/or modify instructions in programs that may 10 be routinely thought of as part of the operating system.

It will also be understood that the embodiments of Figures 3 and/or 4 could be combined. In addition, it is also within the spirit and scope of the present invention to alternately merge some of the procedures of the program 15 library with the associated main program unit.

Example 2 is a further illustration of the method hereof in source code form.

From the foregoing, it will be observed that numerous variations and modifications may be effected 20 without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as 25 fall within the scope of the claims.

- 22 -

EXHIBIT A

5 PARTIAL LIST OF TANDEM'S GUARDIAN
 OPERATING SYSTEM CALLS
 (WITHOUT PARAMETERS)

ALTER
ALTER PRIORITY
10 APS DATA GETPARAM
CONTROL
CREATE
DEFINEADO
DEFINEINFO
15 MEASURINFO
NEWPROCESS
OPEN FILE
PRINTINFO
PRINTREAD
20 READ
WRITE

Page 1 [1] \$SYSTEM.SAVE.EXAMPLE

111] **SYSTEM. SAVE. EXAMPLE**

? INSPECT, SYMBOLS, SAVEZBEND

Copyright 1992, By Overlord Inc., All rights reserved
Author: Don Kennedy

Purpose : To demonstrate a method of intercepting pre-existing computer instructions in order to modify and or enhance pre-existing computer instructions and supply user hooks's, without the requirement and or need of one or more of the following :

A. Viewing the original program unit(s) source code.

B. Viewing the original program unit(s) object code.

C. Re-compiling the original program unit(s) source code.

D. Prior knowledge of the pre-existing computer instructions.

E. A total knowledge of the users present and or future needs.

F. A complete understanding of the pre-existing instructions.

G. Knowing the users purpose or reasons for the interception.

H. That all the pre-existing instructions be executed.

I. All and or any of the user hooks be executed.

J. The result of the pre-existing instructions change.

K. Guidance or expertise from original authors or inventors.

L. Any additional physical, electronic or mechanical device.

NOTE : The procedure chosen to intercept is only used as an example and can and could be changed to or combined with any EXTERNAL procedure CALL from a program unit.

The computer language chosen to demonstrate this example is only used as an example and can and could be changed to or combined with another computer language.

The computer system chosen to demonstrate this example on is only used as an example and can and could be changed to or combined with another computer system or a number of combinations of computer systems.

The intercept method used to demonstrate this example is only used as one example of the method and can and could be changed in order to comply with other computer systems operating systems.

SUBSTITUTE SHEET (RULE 26)

SUBSTITUTE SHEET (RULE 26)

- 25 -

Page 3	[2] \$SYSTEM.SYSTEM.EXTDECS0	Copyright 1992, by Overlord Inc.									
4150.	000000 1 0	EXTERNAL;									
4151.	000000 0 0	?SECTION PROGRAMFILENAME									
4631.	000000 0 0	PROC PROGRAMFILENAME (NAME) CALLABLE;									
4632.	000000 0 0	INT .NAME; OUT !FILE NAME									
4633.	000000 1 0	EXTERNAL;									
4634.	000000 1 0	EXTERNAL;									
4635.	000000 1 0	EXTERNAL;									
NAME	Variable	INT	Indirect	L-003							
4636.	000000 0 0	?SECTION RESERVELCBS									
4838.	000000 0 0	PROC RESERVELCBS (RECEIVECNT, SENDCNT) CALLABLE;									
4839.	000000 0 0	INT RECEIVECNT; IN # TO RESERVE FOR RECEIVE									
4840.	000000 1 0	INT SENDCNT; IN # TO RESERVE FOR SENDING									
4841.	000000 1 0	EXTERNAL;									
4842.	000000 1 0	EXTERNAL;									
4843.	000000 1 0	EXTERNAL;									
4844.	000000 1 0	EXTERNAL;									
RECEIVECNT	Variable	INT	Direct	L-004							
SENDCNT	Variable	INT	Direct	L-003							
4845.	000000 0 0	?SECTION SYSTEMENTRYPOINTLABEL									
5971.	000000 0 0	INT PROC ZGUARD.PCPUCTL (NAME, LEN) CALLABLE;									
5972.	000000 0 0	STRING .NAME; IN IN									
5973.	000000 1 0	INT LEN; IN									
5974.	000000 1 0	EXTERNAL;									
5975.	000000 1 0	EXTERNAL;									
LEN	Variable	INT	Direct	L-003							
NAME	Variable	STRING	Indirect	L-004							
5976.	000000 0 0	\$SYSTEM.SAVE.EXAMPLE 1992-12-04 12:13:07									
source	file:[1] 0	1 SOURCE \$SYSTEM.ZGUARD.PCPUCTL(GETPEEKCONFIGURATION,)									
61.	000000 0 0	2 SOURCE \$SYSTEM.ZGUARD.PCPUCTL(GETPEEKSTATISTICS)									
62.	000000 0 0	3 SOURCE \$SYSTEM.ZGUARD.PCPUCTL 1991-08-06 09:17:53									
source	file:[3] 0	?SECTION GETPEEKSTATISTICS									
63.	000000 0 0	INT PROC GETPEEKSTATISTICS(CPU, BUF, LEN, TIME, PIN, SYSTEM)									
187.	000000 0 0	188. 000000 0 0	189. 000000 1 0	190. 000000 1 0	191. 000000 1 0	192. 000000 1 0	193. 000000 1 0	194. 000000 1 0	195. 000000 1 0	196. 000000 1 0	INT CPU, EXT BUF, LEN, TIME, PIN, SYSTEM;
		FIXED .TIME;									
		INT .PIN;									
		INT SYSTEM;									
		EXTERNAL;									
		Variable INT EXT Pointer									
		Variable INT Direct L-012									
		Variable INT Direct L-013									
		Variable INT Indirect L-010									
		Variable INT Direct L-006									
		Variable INT Direct L-005									
		Variable FIXED (0) Indirect L-007									
227.	000000 0 0	?SECTION GETPEEKCONFIGURATION									

SUBSTITUTE SHEET (RULE 26)

- 26 -

Page 4 [3] \$SYSTEM.ZGUARD.PCPUTL Copyright 1992, by Overlord Inc.

228. 000000 0 0 INT PROC GETPEERCONFIGURATION(CPU, BUF, LEN, TIME, PIN, SYSTEM)
229. 000000 1 0 INT CPU,
230. 000000 1 0 INT .EXT BUF,
231. 000000 1 0 LEN,
232. 000000 1 0 FIXED .TIME;
233. 000000 1 0 INT .PIN;
234. 000000 1 0 INT SYSTEM;
235. 000000 1 0 INT EXTERNAL;
236. 000000 1 0
BUF Variable INT EXT Pointer L-012
CPU Variable INT Direct L-013
LEN Variable INT Direct L-010
PIN Variable INT Indirect L-006
SYSTEM Variable INT Direct L-005
TIME Variable FIXED (0) Indirect L-007

Source file: [1] \$SYSTEM.SAVE.EXAMPLE 1992-12-04 12:13:07
64. 000000 0 0

SUBSTITUTE SHEET (RULE 26)

- 27 -

Page 5 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```

66. 000000 0 0 ****
67. 000000 0 0 Below are the pre and post EXTERNAL user hook definitions for the
68. 000000 0 0 Tandem Guardian TOSVERSION intercept procedures.
69. 000000 0 0
70. 000000 0 0
71. 000000 0 0
72. 000000 0 0 NOTE : The names chosen for the pre and post user hooks are only used as
73. 000000 0 0 an example and these procedures can and could be named other names.
74. 000000 0 0
75. 000000 0 0 The parameters chosen to be passed to the pre and post user hooks
76. 000000 0 0 are used only for example and the number of parameters and or names
77. 000000 0 0 can and could be changed, deleted, and or added to.
78. 000000 0 0
79. 000000 0 0 In this example the pre user hook procedure "before^TOSVERSION^CALL"
80. 000000 0 0 is called from the intercept TOSVERSION procedure passing the Tandem
81. 000000 0 0 Guardian procedure TOSVERSION address.
82. 000000 0 0
83. 000000 0 0 In this example the post user hook procedure "after^TOSVERSION^CALL"
84. 000000 0 0 is called from the intercept TOSVERSION procedure passing the
85. 000000 0 0 Tandem Guardian version level received from the Tandem Guardian
86. 000000 0 0 procedure TOSVERSION.
87. 000000 0 0 ****
88. 000000 0 0
89. 000000 0 0 PROC before^TOSVERSION^CALL( TOSVERSION^procedure^address );
90. 000000 0 0
91. 000000 1 0 INT TOSVERSION^procedure^address;
92. 000000 1 0
93. 000000 0 0 ! TOSVERSION^PROCEDURE^ADDRESS Variable INT Direct L-003
94. 000000 0 0 ! PROC after^TOSVERSION^CALL( Guardian^version^level );
95. 000000 1 0
96. 000000 1 0 INT Guardian^version^level;
EXTERNAL;
GUARDIAN^VERSION^LEVEL Variable INT Direct L-003
97. 000000 0 0 !

```

SUBSTITUTE SHEET (RULE 26)

```
99. 000000 0 0 ****
100. 000000 0 0 ****
101. 000000 0 0 ****
102. 000000 0 0 ****
103. 000000 0 0 ****
104. 000000 0 0 ****
105. 000000 0 0 ****
106. 000000 0 0 ****
107. 000000 0 0 ****
108. 000000 0 0 ****
109. 000000 0 0 ****
110. 000000 0 0 ****
111. 000000 0 0 ****
112. 000000 0 0 ****
113. 000000 0 0 ****
114. 000000 0 0 ****
115. 000000 0 0 ****
116. 000000 0 0 ****
117. 000000 0 0 ****
118. 000000 0 0 ****
119. 000000 0 0 ****
120. 000000 0 0 ****
121. 000000 0 0 ****
122. 000000 0 0 ****
123. 000000 0 0 ****
124. 000000 0 0 ****
125. 000000 0 0 ****
126. 000000 0 0 ****

*****  
TOSVERSION: This is normally a Tandem Guardian operating system CALL that  
program unit(s) would CALL to see what operating system the program unit(s)  
are running on. Then the program unit(s) can determine if the version is a  
proper version of the operating system, and proper action can be taken if  
needed.  
*****  
Since this program unit does not have a MAIN procedure it can be used as a  
User and or System library program unit.  
*****  
When program unit(s) use this program unit as a library, this program unit  
will intercept the TOSVERSION CALL to the Tandem Guardian operating system  
and user hooks CAN be utilized to modify and or enhance the original  
program unit(s).  
*****  
Since many program units may CALL this particular procedure as part of  
their initialization process, it is a good candidate to intercept, so that  
the original program unit(s) can be enhanced and or modified.  
*****  
In this example, TOSVERSION will be intercepted in order to allow user  
hooks to be placed prior to the real TOSVERSION Tandem Guardian CALL as  
well as after in order to modify or enhance the pre-existing program  
unit(s).  
*****
```

- 29 -

```

Page 7 [1] $SYSTEM.SAVE.EXAMPLE
Page 8 Copyright 1992, by Overlord Inc.

128. 000000 0 0 ! INT PROC TOSVERSION;
129. 000000 0 0 ! INT PROC TOSVERSION;
130. 000000 1 0 ! BEGIN
131. 000000 1 0 ! INT .Copyright[0:15] := ["Copyright By O
132. 000000 1 1 ! .Author[0:8] := ["Donald J. Kenn
133. 000000 1 1 ! .overlordversion[0:14] := ["G9030.06.00.O
134. 000020 1 1 ! INT G = 'G',
135. 000031 1 1 ! L = 'L',
136. 000050 1 1 ! S = 'S',
137. 000050 1 1 ! E := 0;
138. 000050 1 1 ! INT pre^user^hook^present := @before^TOSVERSION
139. 000050 1 1 ! post^user^hook^present := @after^TOSVERSION
140. 000050 1 1 ! INT version^level := 0;
141. 000050 1 1 ! TOSVERSION address := 0;
142. 000050 1 1 !
143. 000050 1 1 !
144. 000050 1 1 !
145. 000050 1 1 !
146. 000050 1 1 !
147. 000050 1 1 !

```

SUBSTITUTE SHEET (RULE 26)

Page 8

11] \$SYSTEM.SAVE.EXAMPLE
Copyright 1992, by Overlord Inc.

49. 000050 1
50. 000050 1
51. 000050 1
52. 000050 1
53. 000050 1
54. 000050 1
55. 000050 1
56. 000050 1
57. 000050 1
58. 000050 1
59. 000050 1
60. 000050 1
61. 000050 1
62. 000050 1
63. 000050 1
64. 000050 1
65. 000050 1
66. 000050 1
67. 000050 1
68. 000050 1
69. 000050 1
70. 000050 1
71. 000050 1
72. 000050 1
73. 000050 1
74. 000050 1
75. 000050 1
76. 000050 1
77. 000050 1
78. 000050 1
79. 000050 1
80. 000050 1
81. 000050 1
82. 000050 1
83. 000050 1
84. 000050 1
85. 000050 1
86. 000050 1

NOTE: Using this program unit as a library program unit :

System Library;

If this Program unit is going to be used as a System Library program unit then the Tandem Guardian TOSVERSION Procedure name should be changed to another name using the BIND utility on the pre-existing System Library.

The "TOSVERSION^name" variable should be changed to the new name, also the "TOSVERSION^name^length" variable should be changed to the length in BYTES of the new name.

This program unit should then be compiled and BOUND with the proper pre-existing System Library program unit prior to the OSIMAGE being built.

WARNING : Do not CALL ABEND, DEBUG or STOP in any user hooks if this program unit will be used as a system Library program unit.

With pre-existing User Library;

This program unit should be compiled and BOUND with the proper pre-existing User Library program unit and a new user library program unit should be created and linked to the proper program unit(s).

User Library;

This program unit should be compiled and then linked with the proper program unit(s).

SUBSTITUTE SHEET (RULE 26)

- 31 -

Page 9

[1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```
188. 000050 1 1 ****
189. 000050 1 1 ****
190. 000050 1 1 ****
191. 000050 1 1 ****
192. 000050 1 1 ****
193. 000050 1 1 ****
194. 000050 1 1 ****
195. 000050 1 1 ****
196. 000050 1 1 ****
197. 000050 1 1 ****
198. 000050 1 1 ****
199. 000050 1 1 ****
```

NOTE: Using this program unit as part of a MAIN program unit:
This program unit can be combined with a pre-existing MAIN program unit by doing the following :
A. BIND this program unit into a pre-existing MAIN program unit.

SUBSTITUTE SHEET (RULE 26)

- 32 -

Page 10 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```
201. 000050 1 1 !           .TOSVERSION`name[0:4] := ["TOSVERSION",  
202. 000050 1 1 !           TOSVERSION`name.length := 10;  
203. 000055 1 1 !           STRING .s^TOSVERSION^name := @TOSVERSION`name '<< ' 1;  
204. 000055 1 1 !           TOSVERSION`address := SYSTEMENTRYPOINTLABEL( $TOSVERSION`name,  
205. 000055 1 1 !           TOSVERSION`name.length );  
206. 000055 1 1 !  
207. 000055 1 1 !  
208. 000127 1 1 !  
209. 000134 1 1 !
```

SUBSTITUTE SHEET (RULE 26)

- 33 -

Page 11 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```
211. 000134 1 1
212. 000134 1 1
213. 000134 1 1
214. 000134 1 1
215. 000134 1 1
216. 000134 1 1
217. 000134 1 1
218. 000134 1 1
219. 000134 1 1
220. 000134 1 1
221. 000137 1 1
222. 000142 1 1

! [*****]
| Check to see if the pre^user hook procedure is present and if so then CALL
| the before^TOSVERSION^CALL prior to executing the Tandem Guardian
| TOSVERSION CALL and pass the address of the TOSVERSION procedure.
| [*****]
! [*****]
| IF Pre^user^hook^present > 0 THEN
|   CALL before^TOSVERSION^CALL( TOSVERSION^address );
| [*****]
```

SUBSTITUTE SHEET (RULE 26)

Page 12 [1] \$SYSTEM.SAVE.EXAMPLE

224. 000142 1 1
225. 000142 1 1
226. 000142 1 1
227. 000142 1 1 NOTE : It is possible that the before^TOSVERSION^CALL procedure could
228. 000142 1 1 execute a RETURN statement with its own values which would return
229. 000142 1 1 control to the originating program unit(s) and not execute the
230. 000142 1 1 remaining instructions in this procedure.
231. 000142 1 1
232. 000142 1 1 This could be of value to the user if some program unit(s) must
233. 000142 1 1 be told that they are on operating system versions that they are
234. 000142 1 1 not really on and do not require the real operating system version
235. 000142 1 1 to be checked.
236. 000142 1 1
237. 000142 1 1
238. 000142 1 1

Copyright 1992, by Overlord Inc.

Page 13 [1] \$SYSTEM.SAVE.EXAMPLE Copyright 1992, by Overlord Inc.

```

240.          ***** CALL the Tandem Guardian TOSVERSION procedure and get the Tandem Guardian
241.          000142 1 1 ***** operating system release level.
242.          000142 1 1
243.          000142 1 1
244.          000142 1 1
245.          000142 1 1
246.          000142 1 1
247.          000142 1 1
248.          000142 1 1
249.          000142 1 1
250.          000142 1 1
251.          000143 1 1
252.          000144 1 1
253.          000145 1 1
          RRP 0
          STACK TOSVERSION^address;
          CODE( DPCL );
          STORE version^level;

```

SUBSTITUTE SHEET (RULE 26)

Page 14 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```
255. 000145 1 1 ! [*****  
256. 000145 1 1 ! [*****  
257. 000145 1 1 ! [*****  
258. 000145 1 1 ! [*****  
259. 000145 1 1 ! [*****  
260. 000145 1 1 ! [*****  
261. 000145 1 1 ! [*****  
262. 000145 1 1 ! [*****  
263. 000145 1 1 ! [*****  
264. 000145 1 1 ! [*****  
265. 000150 1 1 ! [*****  
266. 000153 1 1 ! [*****  
      Check to see if the Post^user hook is present and if so then CALL the  
      after^TOSVERSION^CALL prior to returning the value of the Tandem Guardian  
      Operating system level to the originating program unit(s).  
      IF post^user^hook^present > 0 THEN  
          CALL after^TOSVERSION^CALL( version^level );
```

- 37 -

Page 15 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by overlord Inc.

```
268. 000153 1 1
269. 000153 1 1
270. 000153 1 1
271. 000153 1 1
272. 000153 1 1
273. 000153 1 1
274. 000153 1 1
275. 000153 1 1
276. 000153 1 1
277. 000153 1 1
278. 000153 1 1
279. 000153 1 1
280. 000153 1 1
281. 000153 1 1
282. 000153 1 1
```

NOTE : It is possible that the after "TOVERSION" CALL procedure could execute a RETURN statement with it's own values which would return control to the originating program unit(s) and not execute the remaining instructions in this procedure.

000153 1 1

This could be of value to the user if some program unit(s) must be told that they are on a operating system version that they are not really on, but do require that the real operating system version first be checked.

SUBSTITUTE SHEET (RULE 26)

Page 16 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```

284. 000153 1 1 ****
285. 000153 1 1 ****
286. 000153 1 1 ****
287. 000153 1 1 ****
288. 000153 1 1 ****
289. 000153 1 1 ****
290. 000153 1 1 ****
291. 000153 1 1 ****
292. 000153 1 1 ****
293. 000153 1 1 ****
294. 000155 1 1 ****
295. 000155 1 1 ****
                                RETURN version^level;
END;

AUTHOR          Variable   INT   Indirect   L+002
COPYRIGHT       Variable   INT   Indirect   L+001
E               Variable   INT   Direct    L+004
G               Variable   INT   Direct    L+004
L               Variable   INT   Direct    G+000
OVERLORD^VERSION Variable   INT   Direct    L+000
POST^USER^HOOK^PRESENT Variable   INT   Indirect  L+003
PRE^USER^HOOK^PRESENT Variable   INT   Direct    L+006
S^TOSVERSION^NAME Variable   INT   Direct    L+005
TOSVERSION^ADDRESS Variable   INT   Indirect  L+013
TOSVERSION^NAME Variable   INT   Direct    L+010
TOSVERSION^NAME^LENGTH Variable  INT   Direct    L+011
VERSION^LEVEL    Variable  INT   Direct    L+012
                                Direct   L+007

000000 041557 070171 071151 063550 072040 041171 020117 073145 000010 071154 067562 062040 044556 061456 026040 030471 034462
000020 042157 067141 066144 020112 027040 045545 067156 062544 000030 074440 043471 030103 031460 027060 033056 030060 027117
000040 046122 042103 031460 027060 033056 040461 030060 052117 051526 042522 051511 047516 070414 070434 070445
000060 100000 024733 010401 000000 020376 00454 024700 010401 000000 020376 000454 000002 070464 100012 024744 170411
000100 030001 024700 002055 170401 000025 003673 100020 026047 000110 170402 000025 003706 100011 026047 170403 000025 003712
000120 100017 026047 170411 000025 003724 100005 026047 170413 000130 040412 024711 027000 044410 040405 001000 016003 040410
000140 024700 027000 040410 000032 044407 040406 001000 016003 000150 040407 024700 027000 040407 125003

```

296. 000000 0 0 !

Page 17 [1] \$SYSTEM.SAVE.EXAMPLE Copyright 1992, by Overlord Inc.

SUBSTITUTE SHEET (RULE 26)

```

343. 000000 0 0 ****
344. 000000 0 0
345. 000000 0 0
346. 000000 0 0
347. 000000 0 0
348. 000000 0 0
349. 000000 0 0
350. 000000 0 0
351. 000000 0 0
352. 000000 0 0
353. 000000 0 0
354. 000000 0 0
355. 000000 0 0
356. 000000 0 0
357. 000000 0 0
358. 000000 0 0
359. 000000 0 0
360. 000000 0 0
361. 000000 0 0
362. 000000 0 0
363. 000000 0 0
364. 000000 0 0
365. 000000 0 0
366. 000000 0 0
367. 000000 0 0
368. 000000 0 0
369. 000000 1 0
370. 000000 0 0

**** after^TOSVERSION^CALL : This procedure ( IF PRESENT ) can intercept the
**** pre-existing CALL to TOSVERSION after the CALL was placed. Several
**** uses can be made of this user hook. The following list is just a sample
**** of one or more possible ways this user hook could be used:
****

**** A. Do not RETURN the value from TOSVERSION, instead RETURN another value.
**** B. Add additional computer instructions after the TOSVERSION CALL.
**** C. Log a message that the pre-existing instructions CALL TOSVERSION.
**** D. Log a message of the times pre-existing instructions CALL TOSVERSION.
**** E. Count the times that TOSVERSION is CALLED.
**** F. Calculate the time it took to call TOSVERSION.
**** G. Gain access to pre-existing data values in the program unit(s).
**** H. Change pre-existing data values in the program unit(s).

**** The user can change the scope of the original program unit by using this
**** hook without one or more of the requirements listed earlier. This allows
**** the user to have additional options and control on the modification and or
**** enhancements of the pre-existing computer instructions without the need
**** of the original authors and or inventors, guidance and or expertise.
****
```

```

**** PROC after^TOSVERSION^CALL( Guardian^version^level );
**** INT Guardian^version^level;
****
```

- 41 -

Page 19

[1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```
372. 000000 1 0 ****
373. 000000 1 0 ****
374. 000000 1 0 ****
375. 000000 1 0 ****
376. 000000 1 0 ****
377. 000000 1 0 ****
378. 000000 1 0 ****
379. 000000 1 0 ****
380. 000000 1 0 ****
381. 000000 1 0 ****
382. 000000 1 0 ****
383. 000000 1 0 ****
384. 000000 1 0 ****
385. 000000 1 0 ****
```

NOTE : This procedure can be removed from this program unit if needed.

If left empty, it will still be called, but no additional logic will be executed.

User computer instructions can be placed in this area that should be executed after the the REAL TOSVERSION procedure CALL is made, if needed.

Page 20

[1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```

387. 000000 1 0 ****
388. 000000 1 0 ****
389. 00000 1 0 ****
390. 000000 1 0 ****
391. 000000 1 0 ****
392. 000000 1 0 ****
393. 000000 1 0 ****
394. 000000 1 0 ****
395. 000000 1 0 ****
396. 000000 1 0 ****
397. 000000 1 0 ****
398. 000000 1 0 ****
399. 000000 1 0 ****
400. 000000 1 0 ****
401. 000000 1 0 ****
402. 000000 1 0 ****
403. 000000 1 0 ****
404. 000000 1 0 ****
405. 000000 1 0 ****
406. 000000 1 0 ****
407. 000000 1 0 ****
408. 000000 1 0 ****
409. 000000 1 0 ****
410. 000000 1 0 ****
411. 000000 1 0 ****
412. 000000 1 0 ****
413. 000000 1 0 ****
414. 000000 1 0 ****
415. 000000 1 0 ****
416. 000000 1 0 ****
417. 000000 1 0 ****
418. 000000 1 0 ****
419. 000000 1 0 ****

```

The following example is one of may uses that this user hook could be used for.

EXAMPLE : This hook will allow pre-existing program unit(s) using this program unit as a library and making a CALL to TOSVERSION from the original program unit(s), to also CALL the RESERVELCBS procedure, before returning control back to the original program unit(s).

Some of the pre-existing program units may CALL the Tandem Guardian procedure RESERVELCBS later, in this case the later CALL will override this CALL to RESERVELCBS and may require that the RESERVELCBS be intercepted and similar user hook logic be placed in the user hook "before ^RESERVELCBS^CALL".

NOTE : The RESERVELCBS intercept procedure as well as the before RESERVELCBS^CALL and after RESERVELCBS^CALL are not included in this example but the intercept CONCEPT would be the same, and could also be incorporated in this program unit.

Other pre-existing program unit(s) may not currently CALL the RESERVELCBS procedure. This user hook will allow these original pre-existing program unit(s) to be modified and enhanced to CALL the RESERVELCBS procedure if the proper system resources are available and these pre-existing program unit(s) make a CALL to the Tandem Guardian TOSVERSION procedure.

SUBSTITUTE SHEET (RULE 26)

- 43 -

Page 21 [1] \$SYSTEM.SAVE.EXAMPLE Copyright 1992, by Overlord Inc.

Page 22 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

```

462. 000050 1 1 !
463. 000050 1 1 ! INT .cpu^config^buffer [0: ( $LEN( cpu^config^values ) - 1 ) / 2 ];
464. 000050 1 1 ! .cpu^current^buffer [0: ( $LEN( cpu^current^values ) - 1 ) / 2 ];
465. 000050 1 1 ! .cpu^config { cpu^config^values } = cpu^config^buffer,
466. 000050 1 1 ! .cpu^current { cpu^current^values } = cpu^current^buffer,
467. 000050 1 1 !
468. 000050 1 1 ! .current^program^file^name;
469. 000050 1 1 ! INT .EXT x^cpu^config^buffer
470. 000050 1 1 ! := $XADR( cpu^config^buffer );
471. 000050 1 1 ! .EXT x^cpu^current^buffer
472. 000050 1 1 ! := $XADR( cpu^current^buffer );
473. 000050 1 1 ! INT my^cpu
474. 000050 1 1 ! := 0;
475. 000050 1 1 ! my^system^number
476. 000050 1 1 ! := 0;
477. 000050 1 1 ! my^pid
478. 000050 1 1 ! current^percent^lchs^free
479. 000050 1 1 ! allocate^send^lchs
480. 000050 1 1 ! allocate^receive^lchs
481. 000050 1 1 ! program^loop^counter
482. 000050 1 1 ! := $LEN( cpu^config^values );
483. 000050 1 1 ! := $LEN( cpu^current^values );
484. 000064 1 1 ! := [ 12 * [ " " ] ];

```

```

486. 000064 1 1 *****
487. 000064 1 1 *****
488. 000064 1 1 *****
489. 000064 1 1 *****
490. 000064 1 1 *****
491. 000064 1 1 *****
492. 000064 1 1 *****
493. 000064 1 1 *****
494. 000064 1 1 *****
495. 000064 1 1 *****
496. 000064 1 1 *****
497. 000064 1 1 *****
498. 000064 1 1 *****
499. 000064 1 1 *****
500. 000064 1 1 *****
501. 000064 1 1 *****
502. 000064 1 1 *****
503. 000064 1 1 *****
504. 000064 1 1 *****
505. 000064 1 1 *****
506. 000064 1 1 *****
507. 000064 1 1 *****
508. 000064 1 1 *****
509. 000064 1 1 *****
510. 000064 1 1 *****
511. 000064 1 1 *****
512. 000064 1 1 *****
513. 000064 1 1 *****
514. 000064 1 1 *****
515. 000072 1 1 *****
516. 000100 1 1 *****
517. 000106 1 1 *****
518. 000114 1 1 *****
519. 000122 1 1 *****
520. 000130 1 1 *****
521. 000136 1 1 *****
522. 000144 1 1 *****
523. 000152 1 1 *****
524. 000160 1 1 *****
525. 000166 1 1 *****
526. 000174 1 1 *****
527. 000202 1 1 *****
528. 000210 1 1 *****
529. 000216 1 1 *****
530. 000216 1 1 *****
531. 000216 1 1 *****
532. 000216 1 1 *****
533. 000320 1 1 *****
534. 000323 1 1 *****
535. 000330 1 1 *****
536. 000332 1 1 *****

```

The threshold and table settings are located here

NOTE : To add more programs change "max^programs" to increase the size of the program^file^name^table and add program names and set the SEND and RECEIVE LCB values to the proper values for each program in the program^file^name^table". Leave unused entries as *UNUSED* so the empty table space will not be checked.

INT lcb^saftey^threshold := 40; ! At least 40% of the LCB's must be free in order to RESERVE the LCB's in the table. If not, no LCB's will be reserved even if the file name is found.

LITERAL max^programs = 15, ! maximum programs that the table can hold entry^length = 6, ! size of each table entry table^size = max^programs * entry^length;

INT program^file^name^table[0:table^size - 1] :=

Program File Name	Reserve SEND LCB's	Program Entry Number
"BINSERV"	2	1
"COBOL"	2	2
"COMINT"	1	3
"EDIT"	1	4
"ENFORM"	3	5
"FUP"	2	6
"INSPECT"	1	7
"OLORDCPU"	1	8
"OLORDSYS"	1	9
"OLORDMON"	1	10
"PERUSE"	1	11
"SYMSERV"	2	12
"TACL"	1	13
"TAL"	2	14
"*UNUSED*"	1	15
FIXED my^time	0 F;	
my^pid	:= MYPID;	
my^pin	:= my^pid.<8:15>;	
my^cpu	:= my^pid.<0:7>;	
my^system^number	:= MYSYSTEMNUMBER;	

Page 25 [1] \$SYSTEM.SAVE.EXAMPLE Copyright 1992, by Overlord Inc.

```

560. 000362 1 ! current^percent^lcbs^free
561. 000362 1 ! := $INTR( $DBL( cpur^current^lcbs ) * 100D
562. 000362 1 ! / $DBL( cpur^config^total^lcbs ) );
563. 000376 1 ! @current^program^file^name := @program^file^name^table;
564. 000376 1 ! @current^program^file^name = my^program^file^name^table;
565. 000400 1 ! IF lcb^saftey^threshold < current^percent^lcbs^free THEN
566. 000400 1 ! BEGIN
567. 000404 1 ! CALL PROGRAMFILENAME( my^program^file^name );
568. 000404 1 ! FOR program^loop^counter := 0 To { max^programs - 1 } DO
569. 000407 1 ! IF current^program^file^name = my^program^file^name[8] FOR 4 THEN
570. 000411 1 ! BEGIN
571. 000411 1 ! IF lcb^saftey^threshold < current^percent^lcbs^free THEN
572. 000411 1 ! BEGIN
573. 000417 1 ! IF lcb^saftey^threshold < current^percent^lcbs^free THEN
574. 000422 1 ! BEGIN
575. 000425 1 ! allocate^receive^lcbs := current^program^file^name[4];
576. 000431 1 ! CALL RESERVELCBS( allocate^send^lcbs, allocate^receive^lcbs );
577. 000431 1 ! END;
578. 000431 1 ! current^program^file^name := @current^program^file^name[4];
579. 000431 1 ! := @current^program^file^name[4] entry^length;
580. 000434 1 ! IF current^program^file^name = "UNUSED" THEN
581. 000444 1 ! BEGIN
582. 000446 1 ! END;
583. 000453 1 ! END;
584. 000453 1 ! END;
585. 000453 1 ! END;

ALLOCATE^RECEIVE^LCBS Variable INT Direct
AUTHOR Variable INT Direct
COPYRIGHT Variable INT Indirect
CPU^CONFIG Variable, 20 STRUCT-I
CPU^CONFIG^BUFFER Variable INT Indirect
CPU^CONFIG^LENGTH Variable INT Direct
CPU^CONFIG^VALUES Variable TEMPLATE, 20 Direct
CPU^PROCESSOR^TYPE Variable 0, 2 Direct
TOTAL^PCBS Variable 2, 2 Direct
MEMORY^SIZE Variable 4, 2 Direct
SYSPPOOL^SIZE Variable 6, 2 Direct
MAPPOOL^SIZE Variable 10, 2 Direct
TOTAL^LCBS Variable 12, 2 Direct
TOTAL^TILES Variable 14, 2 Direct
TOTAL^BPTS Variable 16, 2 STRUCT-I
CPU^CURRENT^BUFFER Variable 16, 2 Indirect
CPU^CURRENT^LENGTH Variable INT Direct
CPU^CURRENT^VALUES Variable TEMPLATE, 102
CPU^CURRENT^VALUES Variable FIXED(0) Direct
CPU^CURRENT^VALUES Variable 0, 10 Direct
CPU^CURRENT^VALUES Variable 10, 2 Direct
CPU^CURRENT^VALUES Variable 12, 10 Direct
CPU^CURRENT^VALUES Variable 12, 10 FIXED(0) Direct
CPU^CURRENT^VALUES Variable 22, 4 INT(32) Direct
CPU^CURRENT^VALUES Variable 26, 2 INT(32) Direct
CPU^CURRENT^VALUES Variable 30, 10 INT(32) Direct
CPU^CURRENT^VALUES Variable 40, 4 INT(32) Direct
CPU^CURRENT^VALUES Variable 44, 10 INT(32) Direct
CPU^CURRENT^VALUES Variable 54, 4 INT(32) Direct
CPU^CURRENT^VALUES Variable 60, 4 INT(32) Direct

```

Page 26 [1] \$SYSTEM.SAVE.EXAMPLE

Copyright 1992, by Overlord Inc.

SUBSTITUTE SHEET (RULE 26)

- 49 -

```
Page 27 [1] $SYSTEM.SAVE.EXAMPLE

ABEND
AFTER^TOSVERSION^CALL
BEFORE^TOSVERSION^CALL
DEBUG
GETPEEKCONFIGURATION
GETPEEKSTATISTICS
MNPID
MYSYSTEMNUMBER
PROGRAMFILENAME
RESERVELCBS
SYSTEMENTRYPOINTLABEL
TOSVERSION
```

GLOBAL MAP	External								
	8000216	%000000							
			External						
			INT						
			INT						

SUBSTITUTE SHEET (RULE 26)

- 50 -

Page 28 [1] \$SYSTEM.SAVE.EXAMPLE

ENTRY POINT MAP BY NAME FOR FILE: \CLXA.\$WORK.COE.CPATENT2

SP	PEP	BASE	LIMIT	ENTRY	ATTRS	NAME
00	004	000163	000642	000401		AFTER^TOSVERSION^CALL
00	003	000162	000162	000162		BEFORE^TOSVERSION^CALL
00	002	000005	000161	000062		TOSVERSION

LOAD MAPS

SP	PEP	BASE	LIMIT	ENTRY	ATTRS	NAME	DATE	TIME	LANGUAGE	SOURCE FILE
00	004	000163	000642	000401		AFTER^TOSVERSION^CALL	04DEC92	12:28	TAL	\$SYSTEM.SAVE.EXAMPLE
00	003	000162	000162	000162		BEFORE^TOSVERSION^CALL	04DEC92	12:28	TAL	\$SYSTEM.SAVE.EXAMPLE
00	002	000005	000161	000062		TOSVERSION	04DEC92	12:28	TAL	\$SYSTEM.SAVE.EXAMPLE

SUBSTITUTE SHEET (RULE 26)

WHAT IS CLAIMED IS:

1. An apparatus for translating one or more steps of a pre-existing method for carrying out a predetermined function, wherein user defined steps can be incorporated therein, comprising:

circuitry for detecting a step from the pre-existing method which is a candidate for a translation; and

15

2. An apparatus according to claim 1 further including means for determining if a previously defined, user supplied, post-translation set of steps is to be executed after executing any predetermined translation steps, and in response thereto, executing the post steps where indicated.

3. A process of translating one or more steps of a pre-existing method for carrying out a predetermined function, wherein user defined steps can be incorporated therein, in accordance with the apparatus of claim 1, comprising:

30

detecting a step from the pre-existing method which is a candidate for a translation; and determining if a previously defined, user supplied, pre-translation set of steps is to be executed before executing any predetermined translation steps, and in response to the determining step, executing the set of pre-translation steps where indicated.

35

4. The process of claim 3 further including the step of:

5 determining if a previously defined, user supplied, post-translation set of steps is to be executed after executing any predetermined translation steps, and in response thereto, executing the post steps where indicated.

10 5. A method of executing a predefined set of steps, including altering one or more of the steps in a predetermined fashion wherein user defined steps can be incorporated therein, in accordance with the apparatus of claim 1, comprising:

15 detecting a step which is a candidate for alteration;
executing the altering steps; and
determining if a previously defined, user supplied, post-alteration set of steps is to be executed after executing the set of post-alteration steps where indicated.

20 6. The method of claim 5 further including, after the detecting step, the step of:

25 determining if a previously defined, user supplied, pre-alteration set of steps is to be executed before executing any predetermined altering steps, and in response to the determining step, executing the set of pre-alteration steps where indicated.

30 7. A method of intercepting and modifying pre-existing instructions at run time in a computer program being executed in an apparatus as in claim 1, comprising:

35 intercepting a selected instruction and determining if it is a candidate for modification;

determining if an alterable, previously defined, pre-modification set of instructions is to be executed, and in response thereto, executing the pre-modification set of instructions, if any; and

5 modifying or executing the intercepted instruction.

8. The method of claim 7 further including the step of:

10 determining if an alterable, previously defined, post-modification set of instructions is to be executed, and in response thereto, executing the post-modification set of instructions, if any.

15 9. A method of allocating resources within a
multiple node, multiple processor system, wherein at
least some of the nodes are spaced apart and are
interconnected by communication links, wherein one or
more of the processors includes an apparatus as in claim
20 1, the method comprising:

carrying out a sequence of steps in a predetermined process in a selected processor at one of the nodes;

25 detecting a step in the sequence which is to
be carried out and which is a candidate for run-time
modification;

intercepting the detected step and evaluating if a previously defined, operator supplied, pre-modification set of steps exists;

modifying the candidate step using a predetermined sequence of one or more predetermined modifier steps;

- 54 -

subsequent to the modifying step, evaluating if a previously defined, operator supplied, post-modification set of steps exists;

5 executing the operator supplied, post-modification set of steps as indicated; and
 returning to the sequence of steps immediately after the detected step, thereby continuing the process.

1 / 3

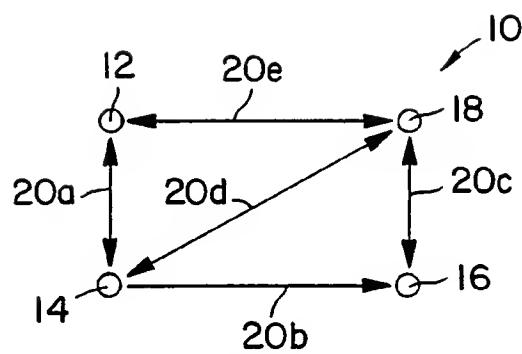


FIG. 1

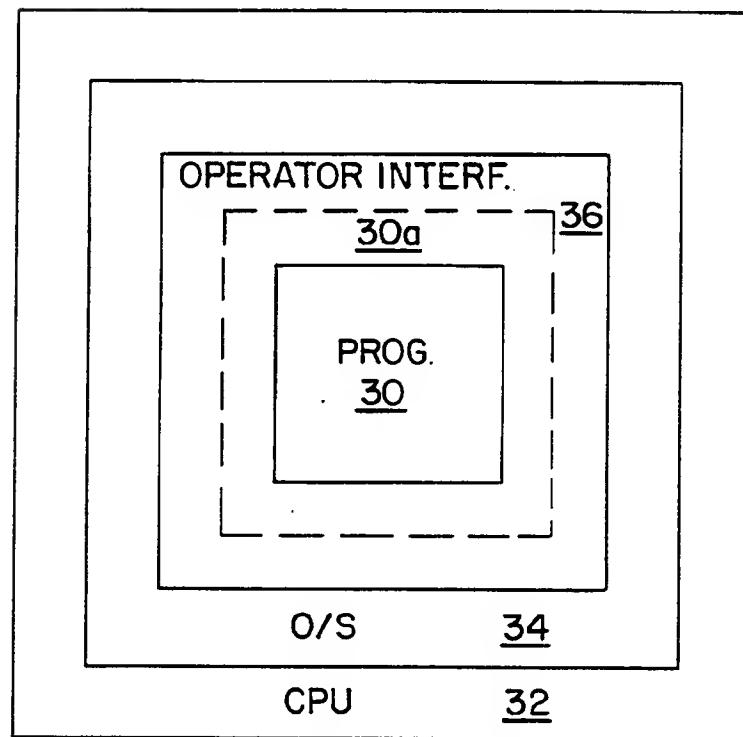
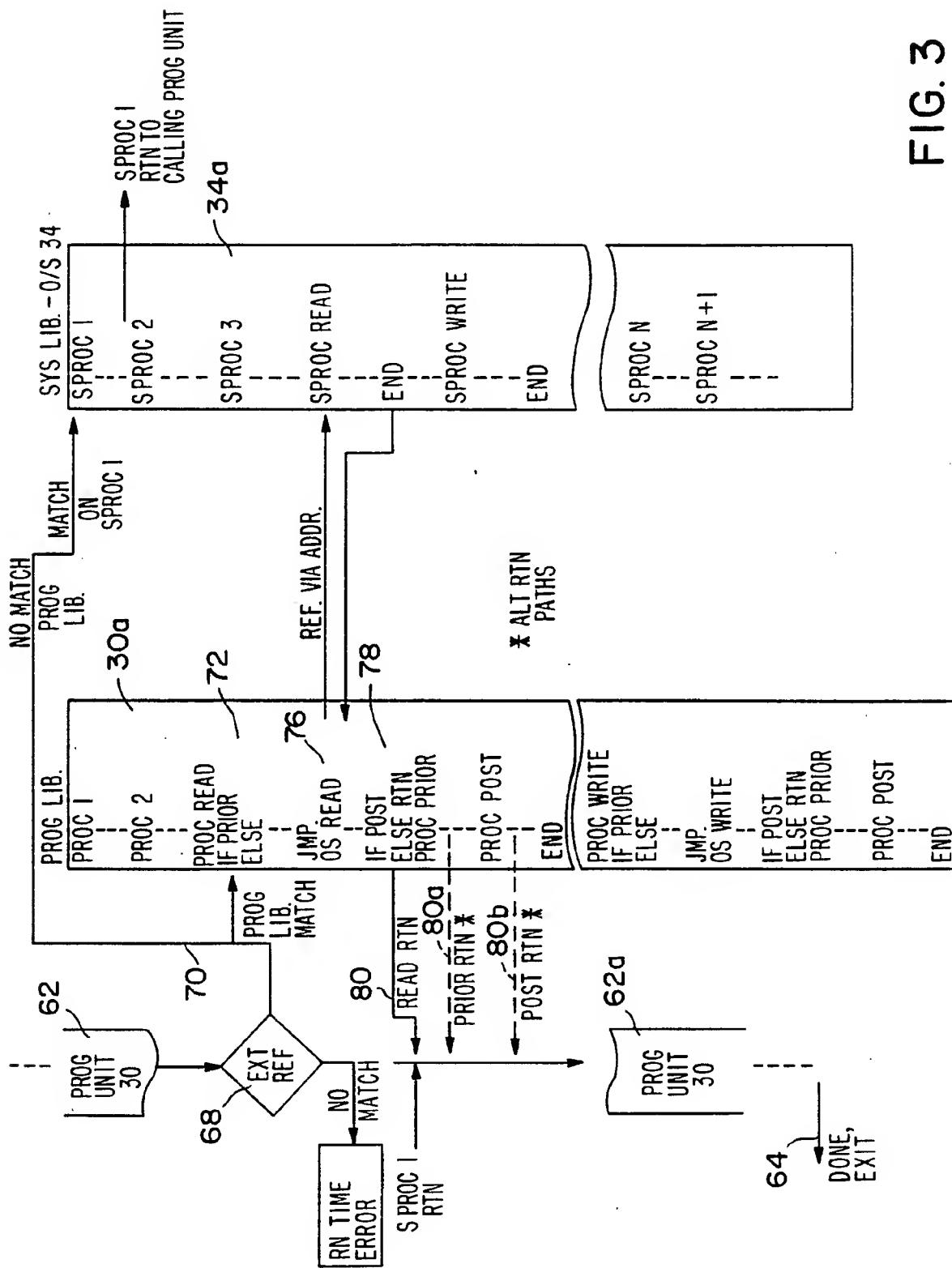


FIG. 2

FIG. 3



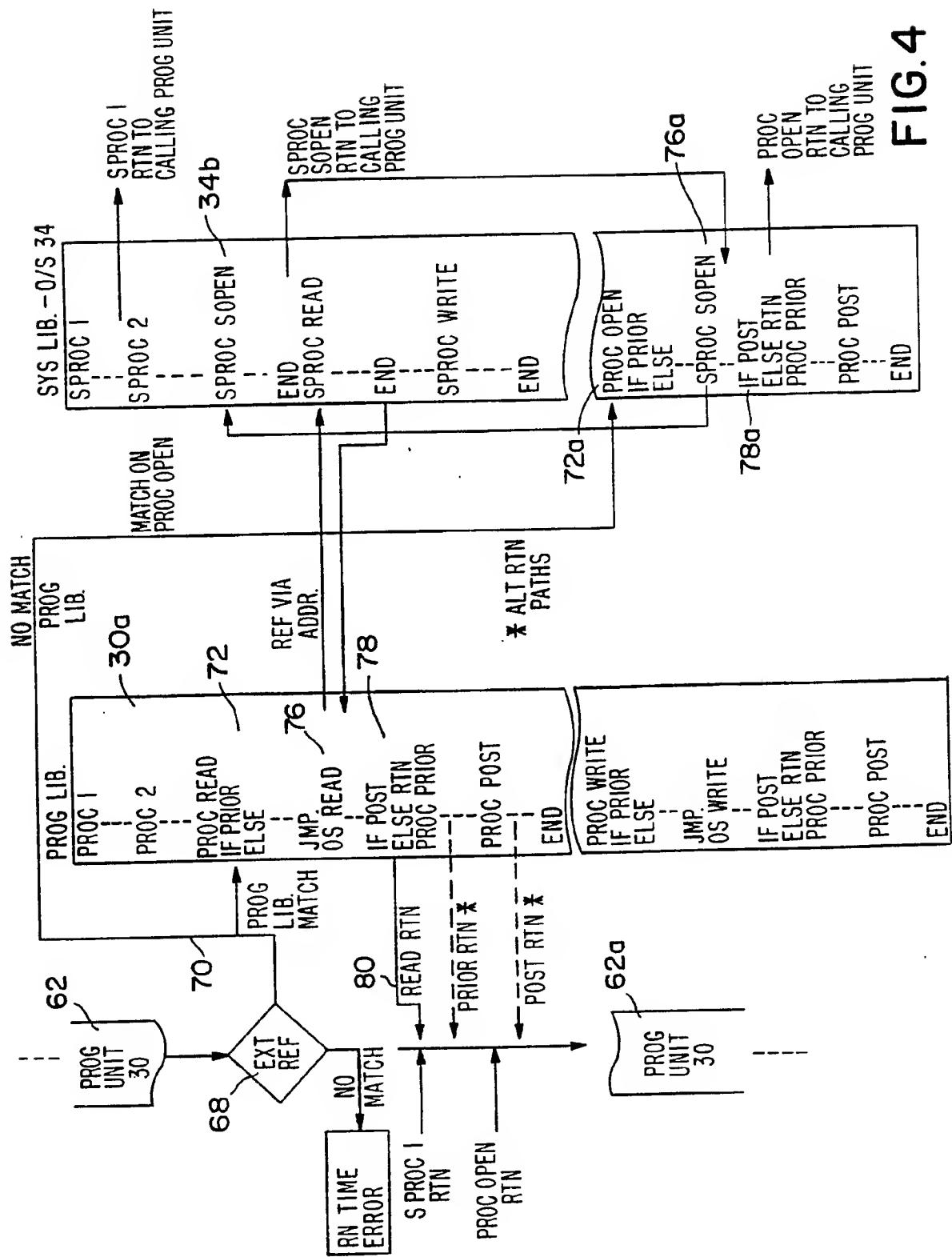


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US93/11506

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : GO6F 9/00; 13/14

US CL : 395/375

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 395/375, 700

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS: search terms: service routine, request, call

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5,109,515 (Laggis et al) 28 April 1992 See abstract. See column 2, lines 37-60, column 3, lines 4-29, column 5, lines 44-68, column 6, lines 14-36, column 7, lines 11-35, and figures 3 and 4.	1-9
Y,P	US, A, 5,241,634 (Suzuki) 31 August 1993 See abstract, column 3, lines 37-68, column 4, lines 1-6 and 11-47.	1-9
X	US, A, 4,768,150 (Chang et al) 30 August 1988 See abstract, column 2, lines 65-68, and column 3, lines 1-53.	1-9
Y		

 Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

19 January 1994

Date of mailing of the international search report

MAR 03 1994

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Authorized officer

Parsh Lall

Parsh Lall

Facsimile No. NOT APPLICABLE

Telephone No. (703) 305-9715

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US93/11506

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5,124,909 (Blakely et al) 23 June 1992 See abstract, column 1, lines 25-68, and column 2, lines 1-13.	1-9

Y		